bers of a pair may separate at this stage. Tetrads sometimes occur at this time. The mantle fibers (*Zugfasern*) are believed to persist from one cell generation to another. The nuclear membrane is a tonoplast, and the nuclear cavity a complex of vacuoles.

Many of the figures look rather diagrammatic, but they are carefully drawn, and the summary indicates that the author, at least, feels certain of his principal conclusions. The work is so extensive and so well presented that it cannot be laid aside; cytologists should either confirm the conclusions or correct them.—CHARLES J. CHAMBERLAIN.

Fungi in rhizoids of liverworts.—Investigation of about thirty species of liverworts by GARJEANE[7] shows that there is no uniformity in the occurrence of fungi in the rhizoids. In some forms the presence of fungi seems to be the rule; in others, especially the bark-inhabiting forms, their presence seems to be the exception. In the same colony individuals with infected rhizoids often occur together with others not infected. The details of the mode of growth of the hyphae are described for *Lophozia inflata* and species of *Cephalozia* and *Cephaloziella*. From the details it appears that the plants in no way profit as a result of the presence of fungi in their rhizoids. On the contrary, the protoplasm in the young rhizoids, and also in the neighboring cells when these are infected, is killed by the fungi. Extended infection of rhizoids is accompanied by sickening of the plants. An interesting reaction of the rhizoids to the attack of the fungus is described in *Lophozia*. When the hypha comes into contact with a rhizoid, a thickening appears on the inside of the rhizoid wall opposite the point of contact. As the hypha grows into the cell, cellulose is continually deposited ahead of the growing point, so that the hypha is surrounded by a sheath of cellulose. Often hyphae pass straight through rhizoids in this way, and become incased in a tube of cellulose. The author was successful in isolating the same species of fungus, described as *Mucor rhizophilus*, from nine species of liverworts. A large number of successful infections was made with this fungus in sterile cultures of *Lophozia inflata*, *Cephalozia bicuspidata*, *Cephaloziella* sp., and *Jungermannia ventricosa*. The author believes that the association of fungus and rhizoid is not of the nature of a mycorhiza; neither does the fungus cause considerable damage to the plant, although strongly infected plants show the unfavorable influence of the fungus.—H. HASSELBRING.

Fall of petals.—FITTING[8] finds that a number of stimuli will cause the premature falling of the corollas of various sympetalous and polypetalous flowers. He worked in the main, however, with *Geranium pyrenaicum*. Among chemi-

[7] GARJEANE, A. J. M., Die Verpilzung der Lebermoosrhizoiden. Flora **102**: 148–185. *pls. 11, 12. figs. 9.* 1911.

[8] FITTING, HANS, Untersuchungen über die vorzeitige Entblätterung von Blüten. Jahrb. Wiss. Bot. **49**:187–263. 1911.

cals that are effective are traces of illuminating gas and tobacco smoke; considerable concentrations of CO_2 (4–50 per cent); high partial pressures of ether and chloroform vapors; and HCl gas. Other effective stimuli are high temperatures, shaking, sprinkling with dust, and wounding the style. FITTING concludes that the process is a vital one, for it does not occur when the plant is in heat rigor or in rigor from lack of oxygen. He also concludes that it is a true stimulus process, showing well-marked presentation and reaction times, as well as typical summation and relaxation. The reaction cannot be attributed to general inhibitory and acceleration effects upon the flowering process, but is a direct stimulatory effect upon the petals. The reaction time varies greatly with the stimulus, age of flower, and species of flower. Traces of illuminating gas give a reaction only after 2–6 hours, while CO_2 in optimum concentration gave a reaction after 30 seconds in *Verbascum thapsiforme*, and after only a slightly longer period in a number of other forms. Reactions to shaking and high temperatures were also rapid. Old flowers were always more sensitive than young ones.

FITTING proposes to call these responses *chorisms*, using the prefixes chemo-, thermo-, seismo-, etc. The paper should prove of considerable economic interest.—WILLIAM CROCKER.

Fundamental units of vegetation.—Ecology as a definite branch of the science of botany, while still in its infancy, has reached a stage in its development at which it is instructive to take an occasional retrospective glance in order to inquire what were the beginnings from which the branch has developed and whether there are tendencies which require pruning or molding. MOSS[9] has taken such a backward look over the course of the development of the concepts and the nomenclature of the units of vegetation most used in the study of plant communities. The look has been a careful one, and has traced "plant associations" from its first use in a floristic sense by HUMBOLDT, in 1806, and with its truer ecological meaning by SCHOUW, in 1822, to the present day. To MOSS the concept seems to be best defined as "a community of definite floristic composition within a formation."

He finds "plant formation" a term and concept of slightly more recent origin, dating to its employment by GRISEBACH in 1838. The different meanings this term has had for various workers are discussed in such a manner as seems likely to lead to some agreement as to its proper content. The desirability of some general agreement as to methods of denoting associations and formations is discussed in a most reasonable manner, and several good suggestions made. The writer is to be commended for correctness of perspective and breadth of view throughout what is doubtless the best historical review of this phase of botany which has yet appeared.—GEO. D. FULLER.

[9] MOSS, C. E., The fundamental units of vegetation. New Phytol. **9**:18–53. 1910.